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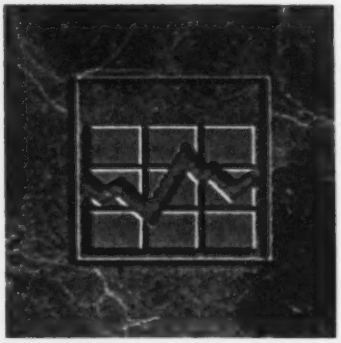
Revising Statistics Canada's Low Income Measure (LIM)



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Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

Abstract

Statistics Canada introduced its Low Income Measure (LIM) in 1991 as a compliment to its Low Income Cut-Offs (LICOs). The Low Income Measure (LIM) is a dollar threshold that delineates low-income in relation to the median income and different versions of this measure are in wide use internationally. Over the intervening 25 years there have been a number of useful methodological and conceptual developments in the area of low income measurement. To make the Canadian LIM methodology consistent with international norms and practices, a revision of the Statistics Canada LIM methodology appears desirable.

This paper describes three modifications to the LIM that Statistics Canada plans to introduce in 2010: replacing the economic family by household; replacing the current LIM equivalence scale by the square root of household size; and taking household size into consideration in determining the low-income thresholds. The paper explains the rationale behind each modification and demonstrates the impacts the revisions will have on low-income statistics in comparison with those under the existing LIM. Overall, the revisions do not have any significant effect on broad historic trends in low-income statistics in Canada. However, compared to the existing LIM the revised LIM produces lower estimates of low-income incidence for certain groups of individuals such as unattached non-elderly individuals.

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1 Introduction

Following a critical review and extensive user consultations on the Low Income Cut-Offs (LICOs), Statistics Canada introduced the Low Income Measure (LIM) as an alternative low-income line in the early 1990s.[1] The LIM is a distribution-based relative measure of low-income. Using the LIM, the low-income status of an individual is determined relative to the incomes of the rest of the society, as opposed to a set of minimum needs. In this sense, the LIM thresholds are independent of country specific aspects of consumer preferences and customs. This characteristic makes LIM particularly appropriate for international comparisons and this is why the Organization of (OECD) uses a LIM methodology to compare low-income across member countries.[2]

The general LIM methodology has also been employed by several Canadian authors to determine low-income thresholds and to study low income and poverty issues in Canada from both an international and national perspective. Osberg and Xu (1999), for example, compared low-incomes across Canadian provinces and between the ten provinces and three countries (Belgium, United States and Sweden). More recently, Veall (2008) examined low-income rates among seniors for Canada, Australia, Germany, Netherlands, the U.K. and the U.S. over a 30-year span. Finally, in 2009 the Province of Ontario has adopted the LIM as one indicator of the progress of its poverty alleviation strategy.

In order to preserve and capitalize on the strength of LIM, a methodological revision is perhaps overdue. Firstly, at the time of its creation, some aspects of the Canadian LIM methodology were different from those employed by other countries and international organizations. For example, economic family is the basic unit of accounting under the Canadian LIM, while internationally household has been the basic unit in which individuals pool their resources.

Secondly, and perhaps more importantly, international practices, such as the equivalence scale adopted to account for the economies of scale in consumption, have evolved over time, while the LIM methodology remains unchanged. Moreover, one of these new norms is a recognition that using multiple different low-income measures can better describe aspects of the complex phenomenon of poverty than a single line. For example Great Britain has officially adopted three different low income lines and the Province of Ontario has adopted two LIM lines and a series of other indicators. The current LIM could thus be strengthened to facilitate international comparisons as well as to provide a relative measure of low-income in the context of other low-income lines in Canada.

This paper proposes three modifications to the existing LIM methodology. Currently, LIM assumes economic family as the basic accounting unit in which individuals pool income and enjoy economies of scale in consumption. Following the practices of the OECD and the LIS, the first modification is to replace economic family by household as the basic accounting unit. Secondly, we propose to replace LIM's Canadian specific

1. For details, see Wolfson et al. (1989).
2. See OECD (2008) for its most recent publication.

equivalence scale by the more widely used square root of household size scale to take into account the economies of scale in consumption. Finally, we propose to change the method by which the low income thresholds are estimated. Under the current methodology, economic families are ranked according to their adjusted incomes, adjusting by family size, and half of the estimated median of this distribution is defined as the standard low-income threshold (for a single adult). We propose to rank individuals rather than economic families to find the median and thus the low-income threshold.

This study reports the effect of each of the above modifications as well as their joint effects on low-income statistics over the past 30 years. We found that the first two modifications led to little change on Canada's low-income statistics, but the third modification turned out to have a significant impact. For example, the overall low-income rates under the existing and the proposed LIMs started to diverge from the mid-1980s, with low-income rates under the revised LIM systematically above those under the existing LIM.

The paper proceeds by first reviewing current LIM methodology and discussing the three modifications. The impact of each independent modification on low-income incidences is then presented followed by an examination of the joint effects of the three modifications. The paper concludes with a summary.

2 The LIM and proposed modifications

2.1 The current LIM methodology

Currently, Statistics Canada produces three types of low income lines: the Low Income Cut-Off, the LIM and the Market Basket Measure. Together, they help policy makers and researchers examine low-income from more than one perspective[3]. Since 1991, the LIM thresholds have been produced for three income concepts: market income, before-tax income and after-tax income.[4] Regardless of the income concept, the calculation involves the following steps:

- For each economic family, calculate the "equivalent size" using its actual size and composition information and the equivalence scale.
- Divide total income of a family by its equivalent size to obtain the "equivalent income".
- Rank all economic families according to their equivalent incomes to obtain the median of the equivalent incomes for all families in the population.

3. It should be kept in mind that while using three low-income lines gives a more complete picture of low-income, low-income itself remains only one facet of economic well being and poverty.
4. Market income is defined as the sum of earnings from employment, investment income, retirement income, support payment received and other incomes such as alimony, severance pay, scholarships, lump-sum payments from pensions and deferred profit-sharing plans received when leaving a plan and supplementary unemployment benefits. Income before-tax, also refered to as total income, is the sum of market income and government transfers, while after-tax income is defined as the above total income minus federal and provincial income taxes.

- Divide the above median by 2 to obtain the "standard LIM threshold", which is equal to the LIM threshold for a single person.
- For families consisting of two or more individuals, multiply the standard LIM threshold by the equivalent sizes of these families to obtain their LIM thresholds.

The equivalence scales are employed to account for the economies of scales in consumption for different family compositions and sizes. A family of two persons needs more income than a single-person family, but not twice as much to maintain the same standard of living. Consequently, if the single-person family needs one unit of income, the two-person family needs more than one but less than two units of income. The equivalence scale system under LIM assigns a one to a single-person family, 1.4 to a two-person family (two adults or one adult and one child under 16 years of age), 1.7 to a three-person family consisting of two adults and one child, etc.[5]

Table 1 contains the after-tax LIM thresholds for the year 2006[6]. Using data from the Survey of Labour and Income Dynamics (SLID), the estimated median of adjusted after-tax family income is $30,358. Thus the standard LIM threshold is $30,358 ÷ 2 = $15,179. The LIM threshold for a single-person family is simply equal to the standard threshold since its equivalent size is unit. For a family of size 2, since its equivalence scale is 1.4, its LIM threshold would be $15,179 x 1.4 = $21,251.

Table 1 The 2006 after-tax LIM thresholds

Number of Adults	Number of children					
	0	1	2	3	4	5
			dollars			
1 adult	15,179	21,251	25,804	30,358	34,912	39,465
2 adults	21,251	25,804	30,358	34,912	39,465	44,019
3 adults	27,322	31,876	36,430	40,983	45,537	50,091
4 adults	33,394	37,948	42,501	47,055	51,609	56,162
5 adults	39,465	44,019	48,573	53,127	57,680	62,234

Source: Survey of Labour and Income Dynamics 2006, authors' calculation.

2.2 Replacing economic family by household

This paper proposes three modifications to the existing LIM methodology. The first is to replace economic family by household as the basic accounting unit in which individuals pool income and enjoy economies of scale in consumption.

As discussed in the previous section, the current LIM methodology uses economic family as the basic accounting unit. The economic family is defined with two conditions: (1) they live in the same dwelling and (2) they are related by blood, marriage (including

5. See more detailed discussion later.
6. Because the aim of this paper is not to present the most recent low-income statistics using the LIM, the reader will find a number of different reference years used throughout.

common-law marriage) and adoption. The vast majority of Canadians live within unique economic family households. In the year 2007, 94.9% of people lived in a household with only one economic family while the other 5.1% of the population was sharing a dwelling with another economic family. As such, only 2.5% of the population lived in secondary economic families within a household. This situation is fairly stable over the last 30 years.

The implicit assumption underlying the LIM methodology is that economies of scale in consumption for each individual are generated from within the economic family only. The assumption may appear reasonable because as just noted the vast majority of Canadians are living exclusively with those who are related to them by blood, marriage, or adoption. Nevertheless, we propose to replace economic family by household, based on two considerations:

First, economic family is not the only unit in which individuals share resources and enjoy the economies of scale in consumption. In some cases individuals from different economic families living in the same dwelling will take turns purchasing certain household consumption goods and services. More to the point, they are able to save on utilities and shelter expenses such as mortgage interest and expenses on heating, cooling, lighting, etc. This is especially important as housing costs represent a large proportion of the consumption of low-income families. For example, two couples, each being an independent economic family, may choose to live in a 2-bedroom apartment, sharing common spaces as well as appliances. These couples will need less income than if living in two one-bedroom apartments and sharing common areas. Under the existing LIM methodology, the above savings are excluded. The proposed modification would take that saving into consideration.

In low income measurement, it is important to take economies of scale into consideration since living arrangements are likely to be correlated with income. It is reasonable to assume that privacy is a normal good. Similar to all normal goods, an increase in income in an economic family will reduce its propensity to share a dwelling with other families or individuals, and a decrease in income will increase the possibility for them to live under one roof. Hence, low-income families or individuals are more likely than their high-income counterparts to trade-off privacy in order to maintain their standard of living. The current LIM methodology ignores the above savings and may thus over-estimate low-income incidence.

Box 1. How Statistics Canada defines economic family?

Economic family is defined as a group of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common-law or adoption. A person who lives alone is also counted as an economic family for statistical purposes of this report.

The economic family concept used by Statistics Canada is compatible with the definition of family within the household presented in the *Principles and Recommendations for Population and Housing Censuses* (United Nations, 1998) which defines a "family within a household" as "those members of the household who are related, to a specified degree, through blood, adoption or marriage".

Secondly and equally if not more important, household is the international standard in comparative statistical surveys of income and well-being while the economic family concept is rarely employed by other countries.[7] Indeed, the United Nations' *Principles and Recommendations for Population and Housing Censuses* (1998), while defining family as "those members of the household who are related, to a specified degree, through blood, adoption or marriage", states that the "degree of relationship used in determining the limits of the family in this sense is dependent upon the uses to which the data are to be put and so cannot be established for worldwide use". Similarly, the Canberra Expert Group on Household Income Statistics in its *Final Report and Recommendations* (2001) considers household as the preferred unit of analysis on income distribution, and this "preference was driven by to a high degree by the relationship of households to both micro (survey) and macro (SNA) data uses". Hence, household rather than the economic family has the maximum international comparability.[8]

7. Canada and the US use similar economic family concepts for low income analysis, however, the US refers to them as census families.
8. According to the Canberra Group (2001), the only difference in defining household among many countries is that some countries impose an "eating together" restriction on household members.

Box 2. How Statistics Canada defines dwelling and household?

A dwelling is defined as a set of living quarters. Two types of dwellings are identified in the census: collective dwellings and private dwellings. The former pertains to dwellings which are institutional, communal or commercial in nature. The latter, private dwellings refers to a separate set of living quarters with a private entrance either from outside the building or from a common hall, lobby, vestibule or stairway inside the building.

A household is defined as being composed of a person or group of persons who co-reside in, or occupy the same dwelling and do not have a usual place of residence elsewhere in Canada or abroad. The dwelling may be either a collective dwelling or a private dwelling. The household may consist of a single economic family, or it may contain two or more families sharing a dwelling. It is also possible for a group of unrelated persons living together or a person living alone to constitute a household.

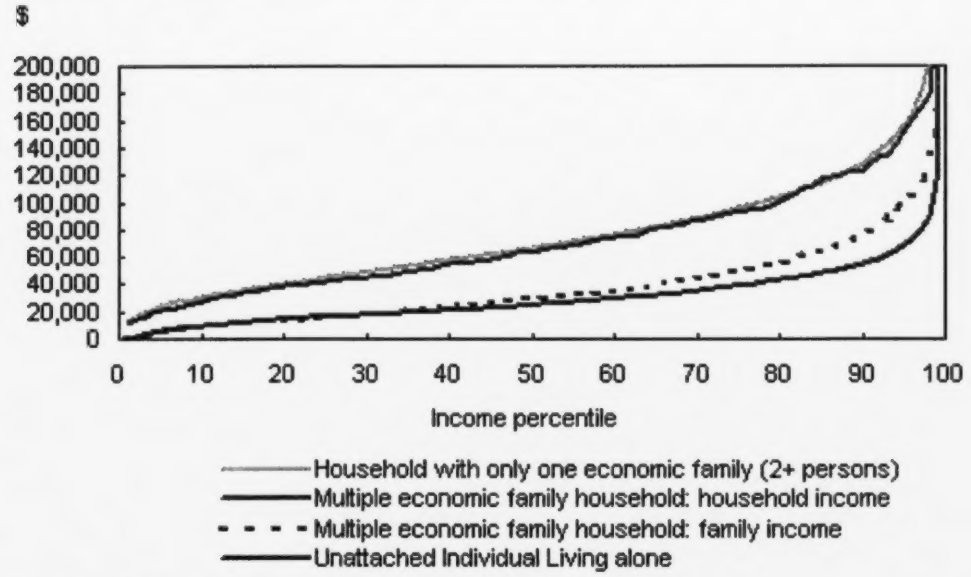
An interesting feature of the modification is that such a change creates a further conceptual difference with two other low-income lines produced by Statistics Canada. However, this difference does not mean we can't compare low-income statistics produced under different lines. In fact, the three low-income lines measure the same phenomena of economic well-being using different assumptions and perspectives. They are all subject to their own set of arbitrary choices and implicit assumptions, and the levels of low-income under different low-income lines are, therefore, not directly comparable with or without the modification. The three low-income lines are designed to complement each other. By allowing LIM to pick up the economies of scale not measured by other lines, LIM becomes a better complement to the LICO and MBM lines.

Under the proposed modification, an individual will be defined as in low-income if the household as a whole is in low-income which in turn will generate different low-income statistics. Under the existing methodology, the economies of scale in consumption are likely under-captured, with respect to shelter costs. As a result, one may end up with upward bias in low-income statistics. On the other hand, since not everything is shared between economic families within a household, the revised LIM may exaggerate the economies of scale. This implies that, other things being equal, low-income statistics under the modification may contain downward bias relative to the existing LIM. Empirically, it is unclear which factor dominates: the upward bias under the existing method or the downward bias under the new method.

It is not expected that the modification will make significant changes in low-income statistics since, as noted earlier, the number of households containing multiple families is not large and is fairly constant over the past 30 years. But it would also appear that those individuals that choose to form multiple economic family households do in fact achieve a household-like distribution of income. As can be seen in Figure 1, persons in households with multiple economic families have a distribution of economic family income that is very similar to that of unattached individuals living in single economic family households.

However, the distribution of household income for those same people closely approximates the shape of the distribution for households with one economic family and two or more persons.

Figure 1 Distribution of Income by Household Type

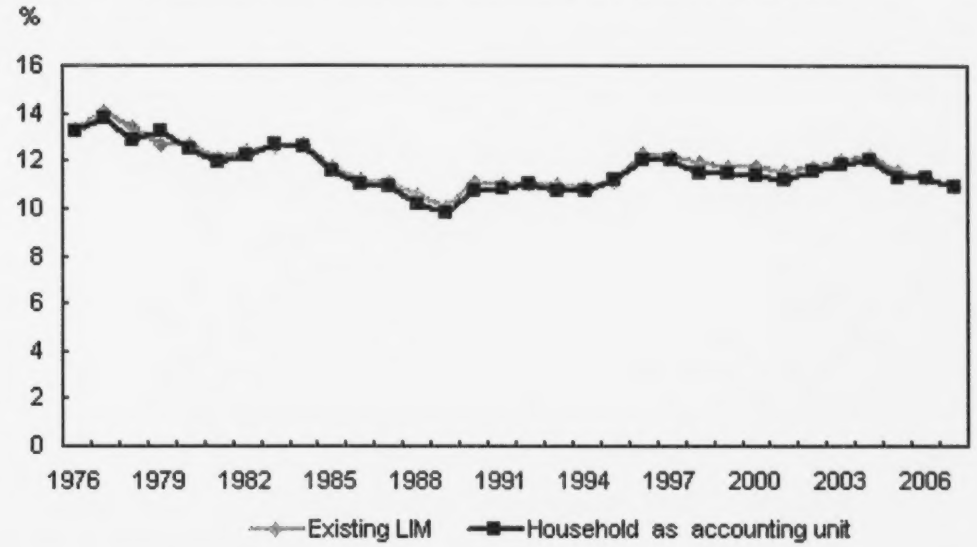


Source: Special Tabulation, Survey of Labour and Income Dynamics (SLID), 2007

Another important point is the fact that the large majority of multiple EF households have relatively small household sizes, implying a conscious choice to form a new household. About 44% of individuals living in multiple EF's live in a two-person household with a further 32% living in three-person households. That is, in three quarters of the cases, two unattached individuals are choosing to live together or an unattached individual is living with a two person economic family.

Figure 2 shows the low-income rates, measured at person level, under the existing LIM methodology and those for which household is adopted as the basic accounting unit, with the existing equivalence scale and weighting scheme. This modification reduces the estimated low-income rates slightly, but does not change the low-income trend in any noticeable way.

Figure 2 Low income rate when economic family is replaced by household



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007)

2.3 Adopting the squared-root equivalence scale

One of the key ingredients under the LIM methodology is to choose the equivalence scale.[9] In essence, the equivalence scale measures how the consumption of an individual will have to change when her/his family status changes such that her/his level of well-being is maintained. For example, a woman lives alone and consumes a basket of goods and services for given prices and attains a certain level of utility. The problem in identifying the equivalence scale for her is to ask how much she would save if she were to live with somebody else, attaining the same utility level as before. Since a person cannot be living alone and together with somebody at the same time, it is generally impossible to identify the equivalence scale for each individual.

Nevertheless, income/resources pooling and sharing do occur within a family or household and economies of scale in joint consumption exist. For example, if two families, each of size two, were to decide to form a new family of size four, the new family would not need as many cars, stoves and refrigerators as when they were living separately to attain their previous levels of satisfaction. They may also be able to take advantage of bulk pricing and volume discounts. Thus, in practice, the equivalence scale is primarily employed to account for savings accrued in consumption expenditures for people who live together. But the problem is that there is no agreement about the degree

9. See Nelson (1993) for a discussion of the conceptual history of equivalence scales.

and extent of the saving, and hence various equivalence scales have been proposed and employed.

The equivalence scales under LIM were chosen as a rough mid-point of several scales embodied in the various series of LICOs and administrative/legislative scales implied by the municipal budget guides and provincial social assistance levels. As Table 2 shows, they fall in between the Old OECD scales (also known as the Oxford scales) and scales derived by Poulin (1988) from Statistics Canada's Income Satisfaction Surveys. These equivalence scales have been employed by Statistics Canada to produce the LIM thresholds since 1991, as well as those extended versions to earlier years. LIM's equivalence scales are also employed by the MBM line.[10]

Table 2 The original equivalence low income mesure scales fall into a middle ground

	Old OECD	Low income mesure scale	Poulin's
First adult	1	1	1
Extra adult	0.7	0.4	0.2
Child	0.5	0.3/0.4 [1]	0.2

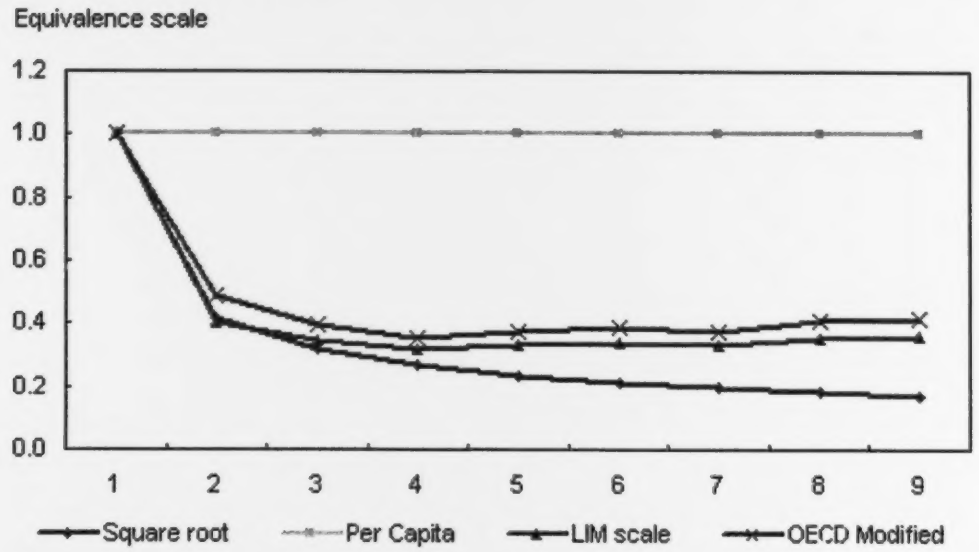
1. When there is only one adult in a family, the first child is counted as 0.4 under LIM

It is worth noting that all equivalence scales are subject to certain assumptions and some arbitrary choices, as accurately summarized by Jäntti and Danziger (2008, P319): "(t)here is no optimal method for deriving an equivalence scale. Indeed, without additional assumptions, there is no way of selecting the basis for choosing an equivalence scale, let alone the correct equivalence scale, out of the multitude that have been suggested". Yet the choice of equivalence scales does evolve over time. This is most evident at OECD. The "Old OECD" scales contained in Table 2 were popular in the 1980s. By the early 1990s, a set of "OECD-modified" scales were adopted by the Statistical Office of the European Union. These modified scales assign a value of 1.0 to the household head, 0.5 to each additional adult and 0.2 to each child. More recently, OECD publications on poverty and inequality typically employ the square root of household size to adjust household income.[11]

We propose to adopt the square root equivalence scale scheme to adjust household income. It is consistent with international practices and it is simple. One aspect of that simplicity is that it is monotonic with respect to family/household size, whereas, other scales are not.

10. Under the MBM methodology, the low income thresholds were estimated for the standard family, consisting of two adults and two children, in the 48 regions. The thresholds for other family types in each region are derived by multiplying the threshold of the standard family in that region by the LIM equivalence scales of these families.
11. OECD (2008)

Figure 3 Average equivalence factor for the Nth family member for various equivalence schemes



Source: Survey of Labour and Income Dynamics (SLID) 2004, Special Tabulations

Figure 3 shows the average equivalence factor of each additional family member. Under the LIM scale and the Square Root scale the second person is always counted as .4. However, the square root has declining factors for each subsequernt member while the LIM scale does not, and thus flattens out after the third member[12]. Furthermore, under the Square Root scale one needs only consider how many people are in the family whereas using the LIM scale one needs to keep in mind both the age of family members as well as whether the family is a single parent family.

This simplicity of function adds to the transparancy and interpretability of results. When comparing countries one needs not be concerned for how the differing family composition affects the low-income rate, as people are treated as individuals.

Some recent empirical research appears to indicate that the square root of household size is a good approximation of the true economies of scale.[13] Under this modification, we expect the low-income rate to be lower than that under the existing equivalence scale since the new scale allows for more saving as can be seen from Figure 3. But again, we do not expect this modification to change low-income statistics in any significant way because the new scheme only differs meaningfully from the existing one when family/household size is large.

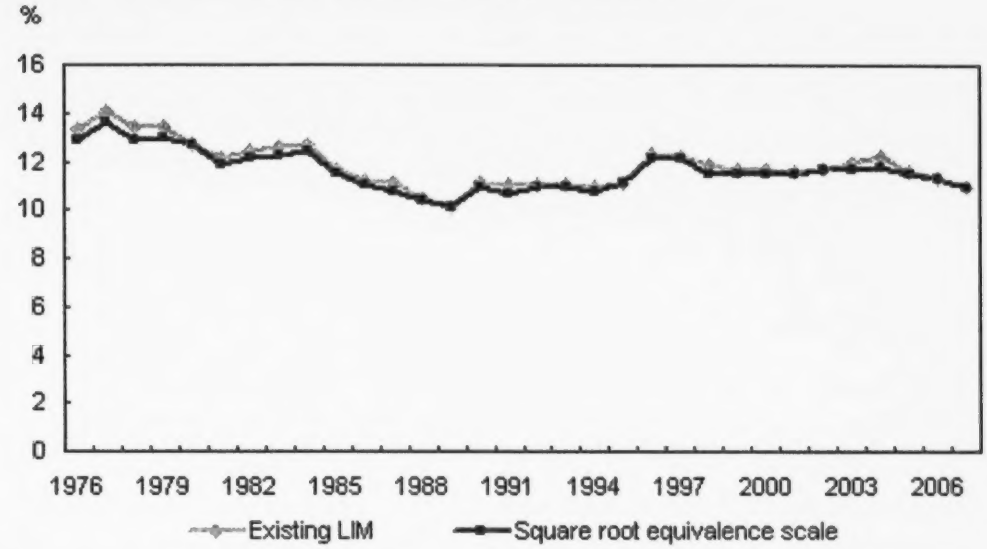
12. The LIM scale falls somewhere between .3(child) and .4(adult) which reflects the differing proportion of adults and children for a given family size in the population.
13. See for example, Fleurbaey and Gaulier (2007).

Table 3 Examples of current and proposed equivalence scales

	Current	Proposed
	%	
Single person with		
no children	1.0	1.0
1 child	1.4	1.4
2 children	1.7	1.7
3 children	2.0	2.0
Two adults with		
no children	1.4	1.4
1 child	1.7	1.7
2 children	2.0	2.0
3 children	2.3	2.2
Three adults with		
no children	1.8	1.7
1 child	2.1	2.0
2 children	2.4	2.2
3 children	2.7	2.4

As demonstrated in Table 3, when family/household size is four or smaller, the two equivalence scales are practically identical. Indeed, the observed low-income statistics under the new equivalence scale are just as expected. Figure 4 shows the low-income rates under the current LIM methodology, except that the equivalence scale is now replaced by the square root of family size. The modification reduces the low-income rates slightly but the differences were not significant, and the low-income trends under the two schemes are the same.

Figure 4 Low-income rate under different equivalence scales



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

2.4 The weighting factor

The economic well-being of individuals is the ultimate concern for policy makers and researchers concerned with welfare economics. For example, Statistics Canada routinely produces statistics on the number of elderly persons or children with low income and government income support payments are made to individuals. However, as noted above, the largest determinant of an individual's economic well-being is the income of the family or household in which they live.

As such, a choice arises as to whether to calculate the median income based on ordering households, economic families or persons. As mentioned earlier, the current LIM methodology ranks economic families and is largely consistent with the LICO in that regard[14]. However, the international norm is to follow the second approach. For example, the Canberra handbook provides the following steps in determining a threshold:

> " Once equivalence scale adjustments have been applied to household income so that household income no longer directly reflects the size of the household, household income weights can be multiplied by the number of people in each unit to derive 'person weights'. By the application of these derived 'person weights' to equivalised household income, estimates of the distribution of income amongst all

14. Wolfson and Evans (1989) point out that while LICO is based on an analysis of households on the Family Expenditure Survey, the thresholds are applied to economic families.

persons can be made. Thus a six person unit 'counts' six times as much as a one person unit."(Canberra, 2001, P41)[15]

Person weighting produces an estimate of the overall distribution of income among individuals in the population, assuming that all household or family incomes are pooled. This procedure is particularly appropriate for comparisons of populations across geography or time where there are large differences in family size or where family size is correlated with income. The individual distribution reflects the assumption that household or family income is shared equally between all members, and does not reflect the direct receipt of income by each individual. Because many household members receive no income, e.g., younger children, this assumption is hard to dismiss in practice pending further advancement in research in this area[16].

The two approaches would generate different low-income statistics if family or household size is correlated with income. As an example, consider a population consists of 11 families and 36 individuals. The numbers of person(s) in those families are 1, 2, 2, 2, 3, 3, 4, 4, 4, 5 and 6, respectively:

Assuming that their adjusted incomes are, respectively,

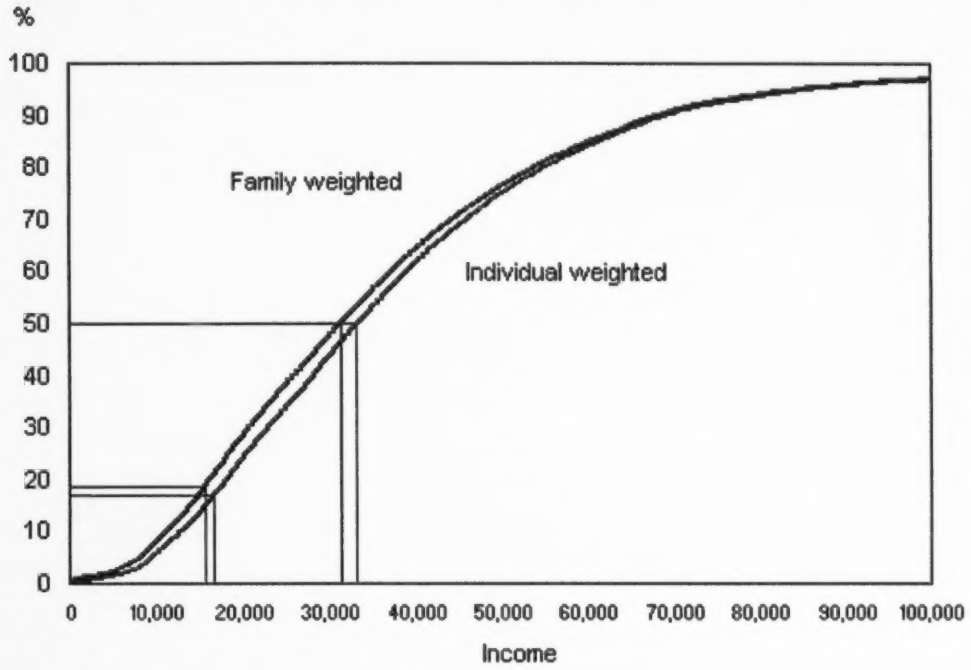
{$15,000; $20,000; $30,000; $40,000; $45,000; $50,000; $60,000; $65,000; $70,000; $80,000; $85,000}

If we rank families according to their adjusted incomes, the estimated median would be $50,000, and half of the median is $25,000. In this case, two out of 11 families are in low- income. Since there are only 3 individuals from these two low-income families, the low-income rate measured at individual level is 8.3% in this population. On the other hand, if we rank individuals as suggested by the Canberra group, the estimated median would be $65,000, implying a low-income threshold of $32,500. Under this scenario, 5 persons from 3 families would be in low-income, resulting a 13.9% of low-income rate at individual level.

More generally, if families or households at the left tail of the income distribution are large in size, while families or households at the right tail are small, the median of the income distribution based on individual weighting would be lower than the median of the distribution based on family or household weighting. On the other hand, when families or households at the left tail are small, while families or households at the right tail are large, individual based median would be higher than family or household based median. The latter case is demonstrated by Figure 5, in which individual-weighted median equals $33,311, while economic family weighted median equals $31,363.

15. This point is also made in the Canadian context by Skuterund, Frenette and Poon, 2004.
16. There are some interesting empirical studies examining the intra-household distribution of consumption however these efforts are not sufficiently advanced so as to provide a robust basis for alternatives to the equal sharing assumption.

Figure 5 Cumulative income distributions under different weighting schemes

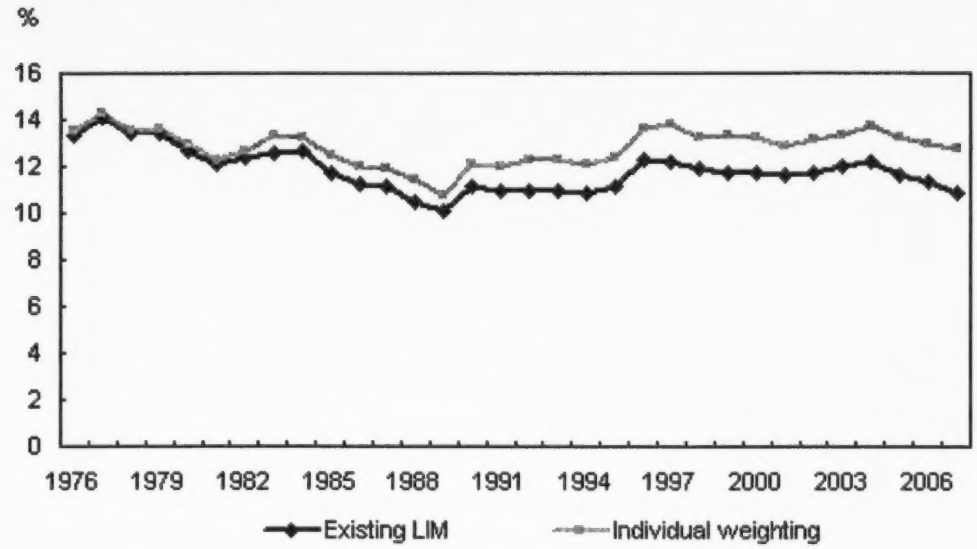


Source:Survey of Labour and Income Dynamics (SLID) 2003.

Notice that the vertical axis in Figure 5 indicates both the proportion of economic families in low income (family weighted line) and the proportion of persons in low income based on the income of their economic family (individual weighted line). Both make use of economic family income. The 18.8% low-income rate at the economic family level is higher than that at individual level. The lower rate for individuals is because the sizes of low-income families are smaller than those of non-low-income families. Indeed, the example from Figure 4 implies a low-income rate of 16.8%.

When we compare the impact of this revised weighting on low-income rates over time, as can be seen from Figure 6, two findings are immediate: On the one hand, the overall low-income trends during the past 30 years were almost identical, no matter which weighting scheme is employed. On the other hand, the estimated low-income rates under the two schemes were similar in the 1970s but they started to diverge in the 1980s, with low-income rates under the new scheme becoming higher over time than those under the existing scheme. In the mid 1980s, the differences were generally less than one percentage point, but by 2007, the difference was approximately two percentage points.

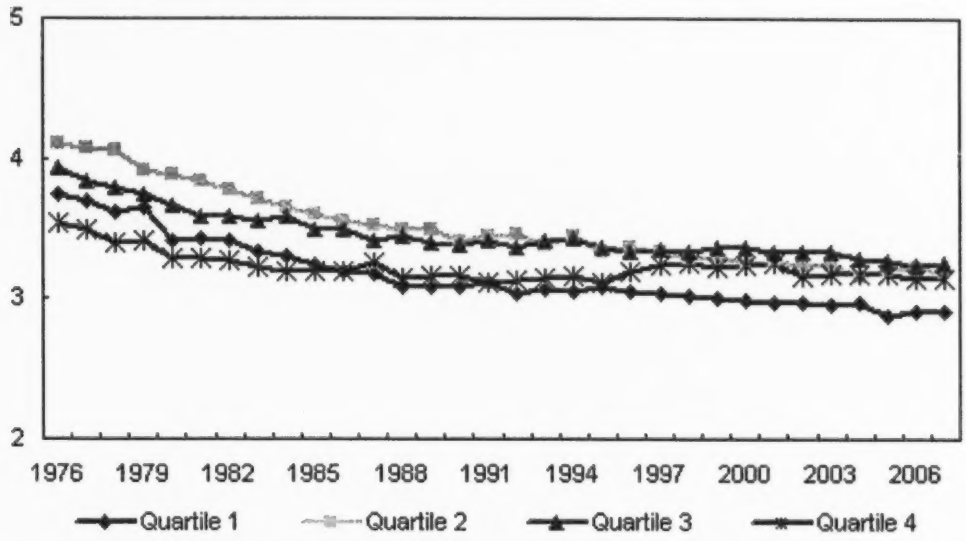
Figure 6 Effect of the person weighting scheme on low-income rate



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

Since the only difference leading to the above result is the weighting factor, a plausible explanation is that the relative family sizes of high and low income families have changed over time. This turns out to have been the case during the past 30 years. Figure 7 shows that in the mid 1970s, there was no clear relation between income and family size. A positive relation would be rejected because families from the top quartile on average had the smallest average family size. A negative correlation would also be rejected because on average, families from the second and the third quartiles were smaller than those from the bottom quartile. But from the mid 1980s, a positive relationship appeared to form between family size and income. Then according to the simple model we discussed at the beginning of this section, when family size and income are positively correlated, the median based on ranking individuals would be higher than that based on family, and a higher standard low-income threshold would be obtained.

Figure 7 Economic family size by income quartile



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

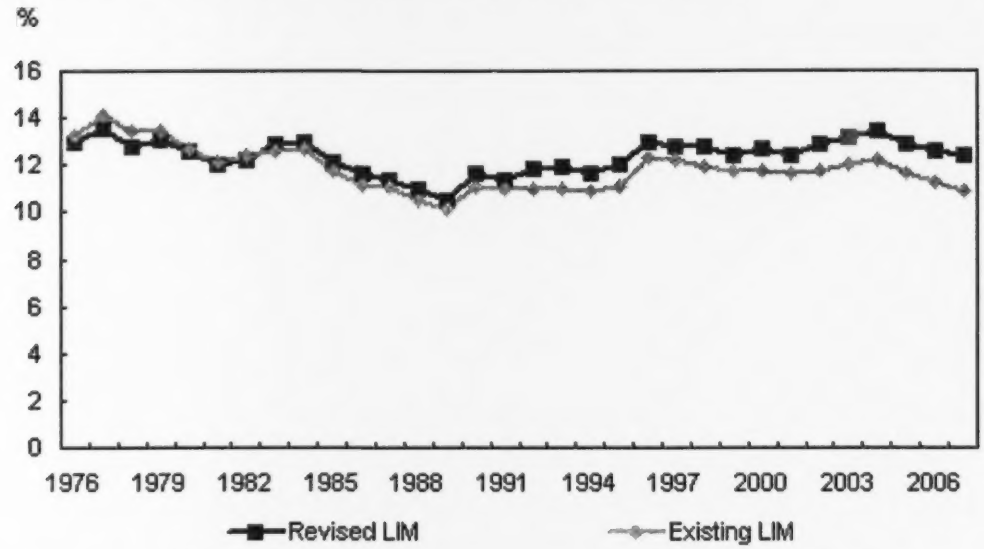
3 What happens to low-income statistics with all three modifications?

We have examined the individual impacts of each of the modifications and the paper now turns to examine the combined effect of the three proposed modifications using the FGT (Foster, Greer and Thorbeck, 1984) family of low-income indexes over time and across several groups of individuals. Section 3.1 focuses on low-income incidences over time and across several groups of individuals, while Section 3.2 presents the low-income gap and severity indexes.

3.1 Low-income rates: overall and across groups of individuals

Our exercises in the previous section indicated that modifying the basic accounting unit from economic family to household and replacing the existing LIM equivalence scale by the square root equivalence scale both tend to slightly reduce our estimated low-income rate. In the other direction, using individual rather than family weighting to estimate the low-income thresholds produces higher low-income thresholds when the sizes of families from the bottom of the income distribution were smaller than that of families from the top quartiles. Since the effects of the first two modifications were small while that of the last modification was large in recent years, we expected that the three modifications, jointly, would result in higher low-income rates for the recent years.

Figure 8 Effects of all three modifications on low-income rate



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

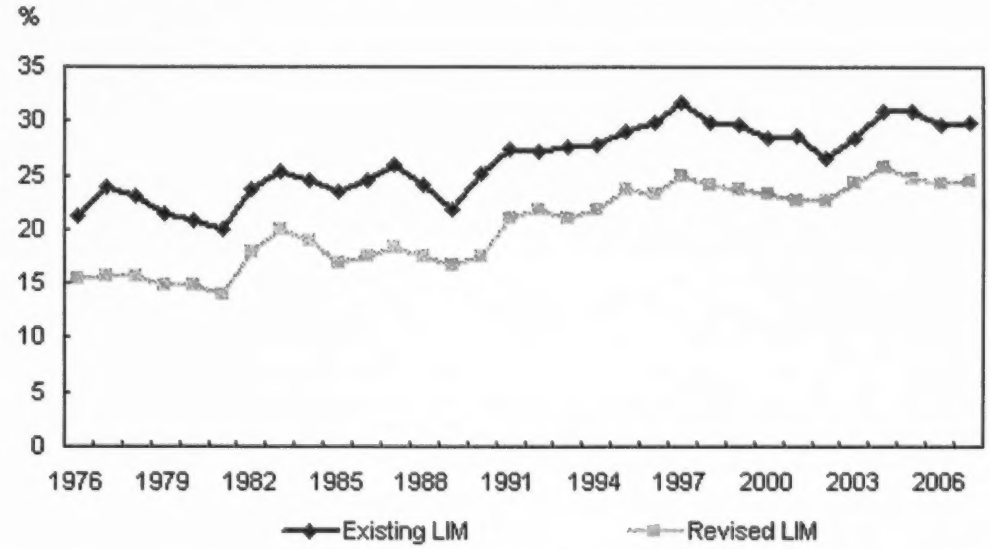
The overall low-income rates are illustrated in Figure 8. While the cyclical movements of low-income in the past 30 years were very similar, no matter which LIM methodology is employed, the levels differed. In the 1970s the revised LIM produced somewhat lower low-income rates than the existing LIM, while in the 1980s low-income rates under the revised LIM became somewhat higher than those under the existing LIM. The differences between the rates during those two periods were small. But since the late 1980s, the difference has been increasing with the revised LIM producing significantly higher low-income incidences than the existing LIM methodology, most likely due to the declining size of families at the bottom of the income distribution.

Similar patterns were observed for different groups of individuals according to their age, province and family types. The only exception was for unattached non-elderly (under 65 years old) men and women. For these individuals, two observations can be made: (1) the low-income rates were about 5 - 8 percentage points lower under the revised LIM than under the existing LIM in the past 30 years and (2) the differences were larger in the 1970s than in more recent years. Figure 9 illustrates these points through the low-income rates for unattached non-elderly men.[17] The conditions for these to occur are that some of the non-elderly unattached low income individuals live with other individuals in the same household, such that their combined income, after adjusting for economies of scale, exceeds the new household's low-income threshold, and over time, the tendency for them to join other households have declined or their combined income increased more slowly than that of other households.

17. The result for unattached non-elderly women is the same.

The main factor behind the first observation is that economic family is replaced by household as the basic accounting unit. By definition, unattached individuals consist of two groups: those who are household members but not members of economic families and those who live alone. Thus, under the existing LIM, each individual from the first group is counted as an economic family, and that the economies of scale he/she enjoyed by living together with other individuals or economic families are not taken into consideration. The proposed modification counts these individuals as household members and thus, any savings they experienced by living together with other individuals are now accounted for.

Figure 9 Low income rates for unattached non-elderly persons (men)



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

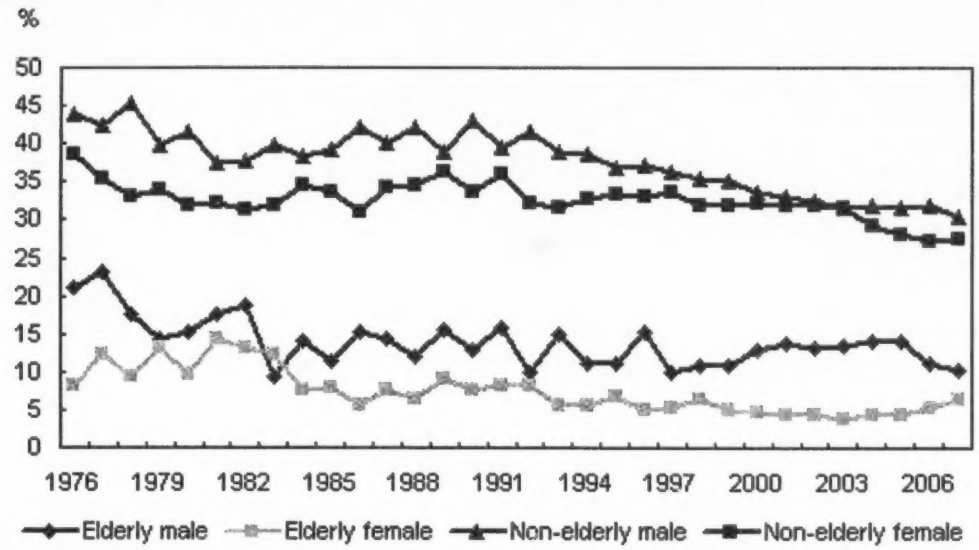
As an example, consider two unrelated young persons living in the same household. Each of them has an after-tax income of $15,000. Suppose that the low-income threshold under the existing LIM is $15,500 while under the revised LIM is higher, say, $16,000. Under the existing LIM, they are both identified as low-income individuals since they are counted as two economic families and each has an equivalence scale of 1, and hence their adjusted after-tax incomes are also $15,000, $500 below the existing threshold. But under the revised LIM, they are counted as one household, whose after-tax income is $30,000. Given the new equivalence scale of $\sqrt{2} = 1.4142$, each of them enjoys an equivalent income of $21,213 (30,000/1.4142), which is well above the low-income threshold of $16,000, even though the threshold under the revised LIM is assumed higher than that under the existing LIM.

Figure 10 contains the proportions of unattached individuals living with unrelated persons/families (or not living alone) from 1976 to 2007. It is striking to observe that

significant proportions of non-elderly men and women lived with other unrelated persons or families. In the mid 1970s, this was the situation for 39% of non-elderly women and 44% of non-elderly men. The proportions varied over time but the general trend was that they declined over time. Recall, however, that the proportion of individuals living in multiple EF households was constant at about 5% over this period and thus, the decline was mostly due to the relative increase in the proportion of individuals living alone in their own household.

By 2007, the proportion had declined to 31% and 28%, respectively. On the other hand, their median incomes had been fairly stable between 1976 and 2007, while the median income of non-elderly family increased 18% during the same period (Figure 11). It appears that our observations of the gap in low income rates for unattached non-elderly individuals under the existing LIM and the revised LIM are consistent with the developments in their living arrangements and their income trends.

Figure 10 Percentage of unattached individuals living with others

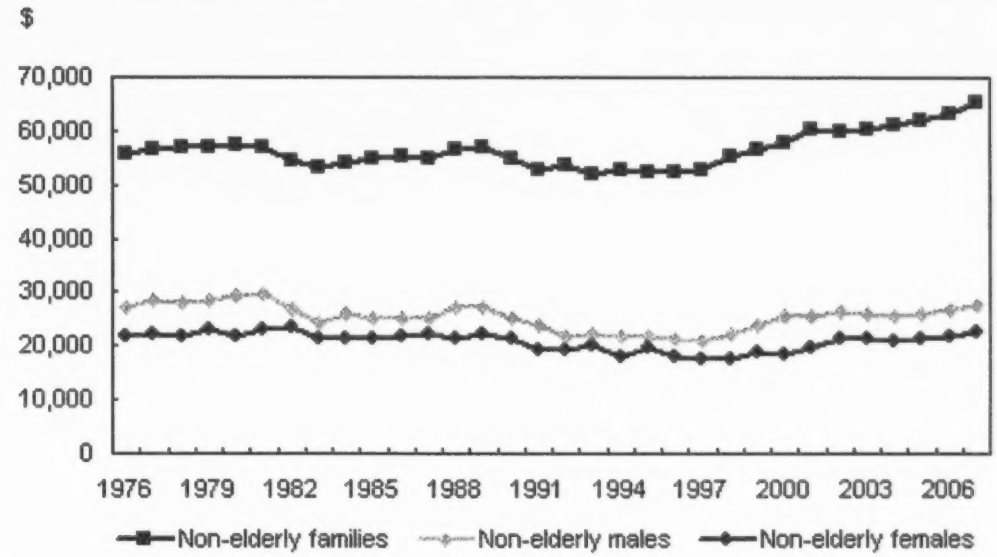


Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

But one question about the above argument is that, unattached elderly individuals may also choose to live with unrelated individuals or families, why then, the pattern on low income incidence for non-elderly unattached individuals does not hold for elderly unattached individuals? A plausible explanation is that few elderly unattached individuals would choose to live with unrelated people such that the savings from living with others were not sufficient to alter the overall low-income statistics under the new LIM methodology. The life-cycle theory predicts that elderly individuals would have accumulated a significant amount of assets which increase their demand for privacy, and hence one expects them to have a low probability of living with unrelated persons or families due to the saving motivation. Figure 10 suggests that this is indeed the case when

comparing to non-elderly unattached individuals: the proportion of elderly unattached Canadians living with others was about 15% in the mid 1970s, and varied around 10% since the mid 1980s.

Figure 11 Median after-tax income of non-elderly families and unattached individuals (2007 constant dollars)



Source: Table 202-0605, CANSIM.

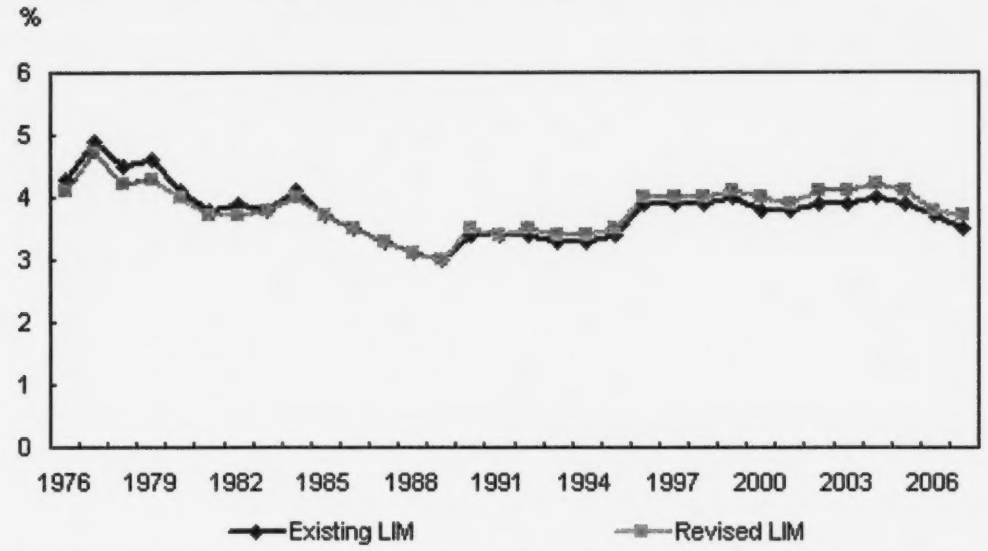
3.2 Low-income gap and severity indexes under the existing and revised LIMs

As Figure 12 indicates, the trends and levels of the low-income gap ratios under the existing and the revised LIMs are practically identical over the past thirty years. The revised LIM was slightly lower than the existing LIM in the late 1970's but by the early 2000's the situation reversed and the revised LIM was slightly higher.

The differences between the gap ratios under the existing and the revised LIMs behaved in a similar fashion to the difference between the incidences (Figure 8), suggesting that the existing LIM might contain some relative bias in the estimated gap ratio due to the structural changes in family and household formation.

Family and household sizes have been declining over time, regardless of income. But by the very nature of the two equivalence scale systems: that the smaller the family/household sizes, the closer are the resulting equivalence scales (see Table 3), it would not be surprising to see the gap ratio of the existing LIM decline relative to a revised LIM that is more sensitive to changes in family size.

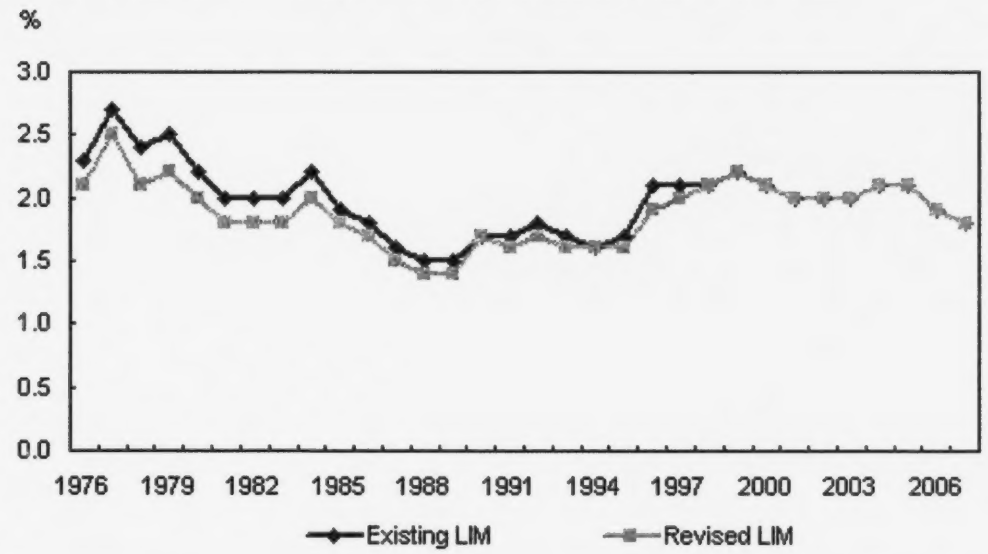
Figure 12 Low-income gap ratios under existing and revised LIMs



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

Figure 13 indicates the same general pattern for low-income severity indexes as was seen for incidences and gap ratios. The trends and levels are practically identical over the past thirty years while the existing LIM declined relative to the proposed LIM.

Figure 13 Low-income severity indexes under existing and revised LIMs



Source: Survey of Consumer Finances (SCF; 1976 to 1995) and Survey of Labour and Income Dynamics (SLID; 1996 to 2007).

The differences in levels in the severity indexes in the 1970s and early 1980s were large enough to be statistically significant for some years. It was unclear which line was biased; however, the difference has disappeared during the past 10 years.

4 Summary

Since the economic well-being of individuals and families is a multi-faceted phenomenon, the state of the art in low-income measurement suggests one needs to adopt a multi-dimensional view. In this respect, a suite of low-income lines is preferred to a single line. In recent years Statistics Canada has adopted this view and annually produces three major lines. Among the three low-income lines, LIM is the only one with which we can conduct valid international comparisons. In order to strengthen this particular characteristic of the LIM, a major revision of the Canadian LIM is perhaps overdue.

The revision is needed for two reasons. Firstly, at its inception, the methodology of the Canadian LIM was not identical to international norms, and secondly, international practices themselves evolved over time. It is desirable to keep the Canadian practices aligned with those of other countries. In this regard, we proposed three modifications: replacing economic family by household as the basic accounting unit in which individuals pool resources and enjoy economies of scale in consumption; replace the Canadian specific equivalence scale by the more popular and widely used square root of household size; and define the standard low-income threshold by the median of individual income distribution rather than family income distribution.

Our empirical results indicate that the first two modifications have little consequence in terms of the low-income incidence, but the third modification systematically increases our estimated low-income rates above those of the existing LIM methodology beginning in the mid 1980s. Underlying this result was the fact that family/household structure has changed over the past 30 years. In the mid 1970s, the size of families/households at the bottom of the income distribution was larger than the size of families/households at the top of the distribution. But since the mid 1980s, this has reversed and families in the bottom quartile are smaller. On the other hand, the new equivalence scale, coupled with declining family/household size over time, appeared to slightly decrease our estimates for the low-income gap and severity indexes.

Overall, we found the modifications are reasonable and worth implementing. They make the Canadian LIM methodology comparable to that of current international practices. At the same time, they do not seem to invalidate the broad trends in low-income statistics observed under the existing LIM. Finally, the modifications create further conceptual differences with the other low-income lines produced by Statistics Canada; for example, taking changing family size into account, and as such provide a good compliment to other threshold measures that facilitate a fuller description of low-income in Canada.

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Appendix A: Glossary[18]

Dwelling

In general terms a dwelling is defined as a set of living quarters. A private dwelling is a separate set of living quarters with a private access. A collective dwelling may be institutional, communal or commercial in nature.

Household

A household is defined as a person or group of persons residing in a dwelling.

Economic family type

"Economic family type" refers to either economic families or unattached individuals. An economic family is defined as a group of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common law or adoption. An unattached individual is a person living either alone or with others to whom he or she is unrelated, such as roommates or a lodger.

Census family type

"Census family type" refers to either census families or persons not in census families. The term "census family" corresponds to what is commonly referred to as a "nuclear family" or "immediate family". In general, it consists of a married couple or common-law couple with or without children, or a lone-parent with a child or children. Furthermore, each child does not have his or her own spouse or child living in the household. A "child" of a parent in a census family must be under the age of 25 and there must be a parent-child relationship (guardian relationships such as aunt or uncle are not sufficient).

Persons "not in census families" are those living alone, living with unrelated individuals, or living with relatives but not in a husband-wife or parent-unmarried child (including guardianship-child) relationship.

By definition, all persons who are members of a census family are also members of the same economic family.

18. http://www.statcan.gc.ca/pub/75-202-x/2007000/technote-notetech1-eng.htm

Definition of income

Total income

Total income refers to income from all sources including government transfers before deduction of federal and provincial income taxes. It may also be called income before tax (but after transfers). All sources of income are identified as belonging to either market income or government transfers.

Income tax

Income tax is the sum of federal and provincial income taxes payable (accrued) for the taxation year. Income taxes include taxes on income, capital gains and RRSP withdrawals, after taking into account exemptions, deductions, non-refundable tax credits, and the refundable Quebec abatement. The data are either taken directly from administrative records or estimated based on aggregate data from administrative records, as this yields better results than the amounts reported by interview.

After-tax income

After-tax income is total income, which includes government transfers, less income tax. It may also be called income after tax.

Classification of income

Market income
- Earnings
  - Wages,salaries and commission
  - Self-employment income
    - Farm
    - Non-farm
- Investment income
- Retirement pensions
- Other income

(plus) Government transfers
- Child tax benefits
  - Child tax benefits
  - Universal child care benefit
- Canada Pension Plan/Quebec Pension Plan benefits
- Old Age Security and Guaranteed Income Supplement/Spouse's Allowance
- Employment Insurance benefits
- Social assistance
- Workers' compensation
- GST/HST Credit
- Provincial/territorial tax credits
- Other government transfers

(equals) Total Income
(minus) Income tax
(equals) After-tax Income
(minus) non-discretionary expenses
(equals) Disposable Income